

## CLAIMS

What is claimed is:

1. A method of producing variable rate filtered samples for use as data in a  
5 secondary process that has prescribed time intervals during which filtered samples are  
required, comprising:  
producing multiple respective periodic sequences of filtered samples each  
having a same sample period, wherein each respective sequence can provide a  
different filtered sample during each sample period and the respective sequences are  
10 offset in time with respect to one another so that no filtered sample from any  
sequence overlaps with any filtered sample from any other sequence; and  
selecting from among the respective sequences filtered samples that coincide  
with the timing requirements of the secondary process.
- 15 2. The method of claim 1, wherein selecting is done from at least one of the  
respective sequences.
3. The method of claim 1, wherein selecting is done from at least two of the  
respective sequences.
- 20 4. The method of claim 1, wherein selecting is done from at least three of the  
respective sequences.
5. The method of claim 1, wherein selecting is done from at least four of the  
25 respective sequences.
6. The method of claim 1, wherein selecting is performed sequentially and  
periodically from at least two of the respective sequences.

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7. The method of claim 1, wherein:  
each respective sequence has a same filter sampling time;  
selecting is performed every prescribed time interval; and  
5 the same filter sampling time is less than the prescribed time interval.
8. The method of claim 1, further comprising generating, from a sensor, sensor  
samples that are used to produce the filtered samples.
- 10 9. The method of claim 8, further comprising controlling a lithographic system  
using the filtered samples, wherein the sensor samples are indicative of a position of a  
stage assembly.
10. The method of claim 9, wherein the stage assembly positions at least one  
15 reticle.
11. The method of claim 9, wherein the stage assembly positions at least one  
wafer.
- 20 12. The method of claim 9, wherein producing generates an output sequence  
comprising a sample train of output samples as filtered samples.
13. The method of claim 1, wherein the sequences have a quantity equal to a value  
governed by the expression: value = maximum of  $\{(T_f/T_{be}) * n$ , for all allowable  $T_{be}\}$ ,  
25 where n is a smallest integer that will result in an integer value for  $(T_f/T_{be}) * n$ ,  $T_f$  is a  
filter sampling time and  $T_{be}$  is a prescribed time interval.

14. The method of claim 13, wherein selecting is performed every prescribed time interval, further comprising changing the prescribed time interval  $T_{be}$ .

15. The method of claim 1, wherein selecting is performed every prescribed time interval, further comprising changing the prescribed time interval  $T_{be}$ , wherein the prescribed time interval  $T_{be}$  comprises a blanking time  $T_b$  and an exposure time  $T_e$  and changing the prescribed time interval  $T_{be}$  comprises increasing the exposure time  $T_e$ .

16. The method of claim 1, wherein selecting is performed every prescribed time interval, further comprising:

changing the prescribed time interval  $T_{be}$ , wherein the prescribed time interval  $T_{be}$  comprises a blanking time  $T_b$  and an exposure time  $T_e$  and each respective sequence has a respective filter sampling time  $T_f$ , and

changing the respective filter sampling time  $T_f$  of each of the respective sequences.

17. The method of claim 16, wherein changing the respective filter sampling time  $T_f$  comprises decreasing the respective filter sampling time  $T_f$ .

18. The method of claim 16, wherein changing the prescribed time interval  $T_{be}$  comprises increasing the prescribed time interval  $T_b$ .

19. The method of claim 1, wherein the secondary process has multiple input sample windows during which it accepts samples, further comprising selecting from among the respective sequences filtered samples that result in respective coincidences of the selected filtered samples and the respective input sample windows for the secondary process.

20. A method of generating at a variable rate a filtered output using a synchronous filter, wherein the filtered output is accepted periodically by a secondary process with a secondary process period  $T_{be}$  and the synchronous filter generates the filtered output with a filter sampling time  $T_f$ , comprising:
- changing the filter sampling time  $T_f$  of the synchronous filter such that the synchronous filter generates the filtered output when the secondary process is able to periodically accept the filtered output;
  - accepting a sensor sample by the synchronous filter;
  - generating the filtered output from the synchronous filter using the sensor sample; and
  - accepting the filtered output by the secondary process.
21. The method of claim 20, wherein the synchronous filter also generates the filtered output when the secondary process is unable to periodically accept the filtered output.
22. The method of claim 20, wherein the filtered output is for controlling a lithography source.
23. The method of claim 20, further comprising sampling a sensor to produce the sensor sample.
24. The method of claim 23, wherein the sensor sample is indicative of a position of a stage assembly.
25. The method of claim 24, wherein the stage assembly positions at least one reticle.

26. The method of claim 24, wherein the stage assembly positions at least one wafer.

5 27. The method of claim 22, wherein:  
the lithography source generates a beam of charged particles;  
the beam has a deflection; and  
controlling the lithography source comprises adjusting the deflection of the  
beam.

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28. The method of claim 20, further comprising increasing the secondary process period  $T_{be}$  such that the synchronous filter generates the filtered output when the secondary process is able to periodically accept the filtered output.

15 29. The method of claim 28, wherein the secondary process period  $T_{be}$  comprises a blanking time  $T_b$  and an exposure time  $T_e$  and increasing the secondary process period  $T_{be}$  comprises increasing the blanking time  $T_b$ .

20 30. The method of claim 20, further comprising increasing the secondary process period  $T_{be}$  wherein:

the secondary process period  $T_{be}$  comprises a blanking time  $T_b$  and an exposure time  $T_e$ ;

increasing the secondary process period  $T_{be}$  comprises increasing the blanking time  $T_b$ ; and

25 after increasing the blanking time  $T_b$ , the secondary process period  $T_{be}$  is substantially an integer multiple of the filter sampling time  $T_f$ .

31. A method of generating at a variable rate a filtered output using a synchronous filter, wherein the filtered output is accepted periodically by a secondary process with a secondary process period  $T_{be}$  and the synchronous filter generates the filtered output with a filter sampling time  $T_f$ , comprising:

- 5           increasing the secondary process period  $T_{be}$  by an amount such that the secondary process is able to periodically accept the filtered output at substantially the same time the synchronous filter produces the filtered output;
- accepting a sensor sample by the synchronous filter;
- generating the filtered output from the synchronous filter using the sensor
- 10   sample; and
- accepting the filtered output by the secondary process.

32. The method of claim 31, wherein the synchronous filter also generates the filtered output when the secondary process is unable to periodically accept the filtered

15   output.

33. The method of claim 31, wherein the filtered output is for controlling a lithography source.

20   34. The method of claim 31, further comprising sampling a sensor to produce the sensor sample.

35. The method of claim 34, wherein the sensor sample is indicative of a position of a stage assembly.

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36. The method of claim 35, wherein the stage assembly positions at least one reticle.

37. The method of claim 35, wherein the stage assembly positions at least one wafer.

38. The method of claim 33, wherein:  
the lithography source generates a beam of charged particles;  
the beam has a deflection; and  
5 controlling the lithography source comprises adjusting the deflection of the  
beam.

39. The method of claim 31, further comprising increasing the secondary process  
period  $T_{be}$  such that the synchronous filter also generates the filtered output when the  
10 secondary process is able to periodically accept the filtered output, wherein:  
the secondary process period  $T_{be}$  comprises a blanking time  $T_b$  and an  
exposure time  $T_e$ ; and  
increasing the secondary process period  $T_{be}$  comprises increasing the blanking  
time  $T_b$ .

15 40. The method of claim 31, further comprising increasing the secondary process  
period  $T_{be}$ , wherein:  
the secondary process period  $T_{be}$  comprises a blanking time  $T_b$  and an  
exposure time  $T_e$ ;  
20 increasing the secondary process period  $T_{be}$  comprises increasing the blanking  
time  $T_b$ ; and  
after increasing the blanking time  $T_b$ , the secondary process period  $T_{be}$  is  
substantially an integer multiple of the filter sampling time  $T_f$ .

25 41. A system for use with a secondary process that requires different filtered  
samples during each of a sequence of input window time intervals, and for providing  
filtered electronic signal samples, comprising:  
multiple filtered sample lines;

multiple filters, each periodically receiving a sample of a signal; wherein:

each filter periodically provides its filtered sample sequence to a filtered sample line with a respective filter sampling time  $T_f$ , and

the respective filtered sample sequences are offset in time with respect to one another so that no filtered sample from any filtered sample sequence overlaps with any filtered sample from any other filtered sample sequence;

a multiplexer responsive to control signals and coupled to each of the multiple filtered sample lines; wherein:

the multiplexer accepts the respective periodic filtered output of each of the multiple filters, and

the multiplexer has a multiplexer output; and

control logic providing control signals causing the multiplexer to:

select from among the filtered sample lines in a sequence results in respective coincidences of respective filtered samples on respective selected filtered sample lines and respective input sample windows for the secondary process, and sequentially provide respective filtered samples on respective selected lines as a sequence of filtered input for use by the secondary process.

42. The system of claim 41, wherein the sequence of filtered input is produced using less than all of the respective filtered sample sequences accepted by the multiplexer.

43. The system of claim 41, wherein the secondary process is controlled using the sequence of filtered input.

44. The system of claim 41, wherein the secondary process comprises a source for lithography that is controlled using the sequence of filtered input.



45. The system of claim 41, further comprising a sensor that generates the signal.

46. The system of claim 45, further comprising an analog-to-digital converter that periodically generates the sample of the signal.

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47. The system of claim 46, wherein the sample is indicative of a position of a stage assembly.

48. The system of claim 47, wherein the stage assembly positions at least one  
10 reticle.

49. The system of claim 47, wherein the stage assembly positions at least one wafer.

15 50. The system of claim 44, wherein:  
the lithography source generates a beam of charged particles;  
the beam has a deflection; and  
the deflection of the beam is controlled by the sequence of filtered input.

20 51. The system of claim 41, wherein:  
the secondary process has a prescribed time interval  $T_{be}$  by which the input  
sample windows are spaced; and  
the prescribed time interval  $T_{be}$  is less than the filter sampling time  $T_f$ .

25 52. The system of claim 41, wherein:  
the multiple filters are programmable filters; and  
the respective filter sampling time of each programmable filter can be  
changed.

the prescribed time interval  $T_{be}$  has multiple allowable values; and  
the multiple filters have a quantity equal to a value governed by an expression:  
value = maximum of  $\{(T_f/T_{be}) * n$ , for all allowable  $T_{be}\}$ , where  $n$  is a smallest integer  
that will result in an integer value for  $(T_f/T_{be}) * n$ .

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56. The system of claim 54, further comprising an analog-to-digital converter generating the sample of the signal.

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58. The system of claim 57, wherein the stage assembly positions at least one reticle.

5 59. The system of claim 57, wherein the stage assembly positions at least one wafer.

60. The system of claim 57, wherein the beam has deflection that is controlled by the output sequence.

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61. The system of claim 54, wherein a prescribed time interval  $T_{be}$  is less than the filter sampling time  $T_f$ .

62. The system of claim 54, wherein:

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the multiple synchronous filters have a quantity;

the sequence is a periodic sequence with a prescribed time interval  $T_{be}$  having multiple allowable values; and

the quantity is equal to a value governed by an expression: value = maximum of  $\{(T_f/T_{be}) * n$ , for all allowable  $T_{be}\}$ , where  $n$  is a smallest integer that will result in  
20 an integer value for  $(T_f/T_{be}) * n$ .

63. A method of exposing a wafer to an electron beam in a microlithography apparatus, comprising:

25 acquiring, from a sensor, data indicative of a position of a stage assembly that positions the wafer;

calculating, from the data, a velocity of the stage assembly and an acceleration of the stage assembly;

estimating, using the velocity and the acceleration, a future position of the stage assembly;

determining a difference between the position and the future position; and  
adjusting at least one of:

- 5                   the position within a predetermined position error, and  
                  a deflection amount of the electron beam.

64.     The method of claim 63, wherein acquiring comprises asynchronous data acquisition.

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